PATENT ABSTRACTS OF JAPAN

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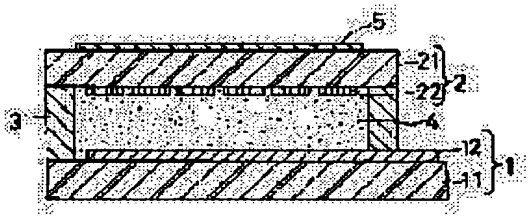
(54) REFLECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE AND ITS PRODUCTION

(57)Abstract:
PURPOSE: To provide a reflection type liquid crystal display device which is free from the display defects occurring in a process for production of the device and a process for production of such display device on a premise of the liquid crystal display device having light reflective metallic electrodes essentially consisting of silver.

CONSTITUTION: The main parts of this reflection type liquid crystal display device are composed of a rear surface electrode plate 1, an observer side electrode plate 2 oriented to face this rear surface electrode plate 1, a sealing material 3 integrating both electrode plates in a peripheral part and a liquid crystal material 4 encapsulated between these two electrode substrates. The rear surface electrode substrate 1 has metallic electrodes 12 which consist essentially of silver and contain magnesium by 15atm.% and tin by 10atm.%. An intermetallic compd. of these metals is formed in the boundary region of the metal electrodes 12 and a glass substrate 11, by which the adhesive power thereof is increased. On the other hand, the magnesium bonds to the oxygen in the air and forms an oxide on the surfaces of the metallic electrodes 12. Flawing and decoloring are prevented by the effect of this oxide. The reliability of the liquid crystal display device is thus improved.



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CLAIMS

[Claim(s)]

[Claim 1] A back plate board which has a metal electrode of light reflex nature This back plate board is countered, and it is arranged, and is a transparent electrode. It is the reflective mold liquid crystal display equipped with the above, and the above-mentioned metal electrode uses silver as a principal component, and is characterized by containing the 2nd element which can form an intermetallic compound with the 1st element which could form an intermetallic compound and was excellent in adhesion with a substrate of the above-mentioned back plate board with silver, and silver or the 1st element.

[Claim 2] A reflective mold liquid crystal display according to claim 1 characterized by content of silver in the interior of the above-mentioned metal electrode being higher than content in the surface of a metal electrode.

[Claim 3] A reflective mold liquid crystal display according to claim 1 or 2 characterized by the 1st element of the above consisting of one sort or two sorts or more of elements chosen from Mg, In, aluminum, Ti, Zr, Ce, or Si.

[Claim 4] A reflective mold liquid crystal display according to claim 3 with which the 1st element of the above is characterized by consisting of Mg or In.

[Claim 5] A reflective mold liquid crystal display according to claim 1 to 4 characterized by the 2nd element of the above consisting of one sort or two sorts or more of elements chosen from Sn, Sb, nickel, Zn, Cd, Pd, Au, Bi, germanium, Ga, Cu, Mn, Ba, Fe, or La.

[Claim 6] A reflective mold liquid crystal display according to claim 5 with which the 2nd element of the above is characterized by consisting of Sn.

[Claim 7] A manufacture method of a reflective mold liquid crystal display which is equipped with liquid crystal material enclosed between an observer lateral electrode board which counters a back plate board which is characterized by providing the following, and which has a metal electrode of light reflex nature, and this back plate board, and is arranged, and has a transparent electrode, and two-electrodes boards, such as this, impresses voltage between two electrodes, is made to drive liquid crystal material, and carries out a screen display The 1st element which could use silver as a principal component on a substrate of the above-mentioned back plate board, could form an intermetallic compound with silver, and was excellent in adhesion with the above-mentioned substrate A membrane formation production process which forms a thin film which contains the 2nd element which can form an intermetallic compound with silver or the 1st element

A patterning production process which carries out patterning of the formed thin film to an electrode configuration A heating production process which a thin film by which patterning was carried out is heat-treated [production process], and increases content of the above-mentioned silver in the interior of a thin film

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to a reflective mold liquid crystal display and its manufacture method, and especially, a screen display with it is possible for it, and it relates to the highly reliable reflective mold liquid crystal display which moreover bears the terms and conditions in a manufacturing process and amelioration of the manufacture method. [the high rate of a light reflex and] [bright]
[0002]
[Description of the Prior Art] The principal part consists of liquid crystal material by which the liquid crystal display was enclosed between the electrode board of the pair in which the electrode which can impress voltage for every picture element was arranged, and electrode boards, such as this. While controlling the plane of polarization of the light which the orientation condition of liquid crystal material is changed for every picture element, and penetrates this liquid crystal material by impressing voltage between the above-mentioned two electrodes, it controls its transparency and un-penetrating by the polarization film, and a screen display is performed. And the display of a color screen is attained by applying the electrode board which has a color filter layer to one side of the electrode boards of a up Norikazu pair.
[0003] By the way, as this kind of a liquid crystal display, the light source (lamp) is arranged on the rear face or the side of an electrode board (a back plate board is called below) which it is located in the back side of a liquid crystal display, and the formula transparency mold liquid crystal display with a built-in lamp of the back light mold to which incidence of the light is carried out from a back plate board side, or a light guide mold has spread widely.
[0004] However, in order that power consumption with that lamp might consume displays of other classes, such as CRT and a plasma display, and the power of an abbreviation EQC greatly in this formula transparency mold liquid crystal display with a built-in lamp, the feature of the low power of liquid crystal display original was spoiled, and it had the defect that use of the long duration in a carrying place became difficult.
[0005] On the other hand, while carrying out incidence of the outdoor daylight, such as indoor light and the natural light,

from the electrode board (an observer lateral electrode board is called) located in the observer side of equipment and reflecting this incident light with a light reflex nature back plate board, without building in such a lamp, the reflective mold liquid crystal display which carries out a screen display by this reflected light is also known. And in this reflective mold liquid crystal display, since a lamp is not used, power consumption has the advantage that it is small and equal to a long duration drive at a carrying place.

[0006] As such a reflective mold liquid crystal display, as shown in drawing 7 , the electrode a2 of the back plate board a is constituted from a metal thin film, for example, and what is made to reflect incident light with this metal electrode a2, and carries out a screen display is known. In addition, red, the color filter layer made to color green and blue, and b3 show the protection-from-light film for the light in which the seal member which an observer lateral electrode board and c unify by liquid crystal material, and d makes unify the back plate board a and the observer lateral electrode board b by the periphery, b2R, b2G, and b2B are prepared in the part corresponding to the picture element section, and b penetrates at least each part among drawing, respectively.

[0007] And although it was cheap and the aluminum thin film with the high rate of a light reflex was conventionally used as a metal electrode a2 of the above-mentioned back plate board a, moisture and a base were easy to be corroded and this aluminum thin film had the defect of having produced a fall and open circuit of the rate of a light reflex in connection with this, and being easy to cause a display defect.

[0008] Then, the reflective mold liquid crystal display which replaces with the above-mentioned aluminum thin film, and uses a stable silver thin film to moisture or a base is proposed. That is, in this silver thin film, if 1%NaOH aqueous solution immersion processing for 5 minutes (required in the manufacturing process of a liquid crystal display) is performed to an aluminum thin film with a thickness of 0.2 micrometers prepared on the glass substrate, the aluminum thin film has the advantage which is not influenced at all even if the same immersion processing is performed to dissolving completely and disappearing.

[0009]

[Problem(s) to be Solved by the Invention] Thus, although the silver thin film had the outstanding chemical stability, on the other hand, the silver thin film was a soft metal, and since the adhesion force with the substrate of a back plate board was inferior again, it had the trouble of the assembler of a liquid crystal display having got damaged in inside, or being easy to exfoliate from a substrate. for example, a point

R0.025mm diamond stylus and **** -- although an aluminum thin film scratches and line breadth is only 106 micrometers, when the comparative study of the **** reinforcement of the above-mentioned aluminum thin film and the **** reinforcement of a silver thin film is carried out using the trade name HEIDON by strength test machine [New East Science company -- receiving -- a silver thin film -- scratching -- a part -- as a center -- large -- exfoliating -- the -- it scratches and measurement of line breadth becomes impossible.

[0010] And it had the trouble of spoiling the reliability of the liquid crystal display manufactured since the blemish produced in metal electrodes, such as this, and exfoliation became the cause which causes a display defect all over the screen of a liquid crystal display.

[0011] Moreover, when a back plate board was kept in long duration air in the manufacturing process of a liquid crystal display, the oxide and the sulfide were formed in the surface of the above-mentioned silver thin film, it was [it was discolored in black, or] easy to brown, and there was also a trouble of the rate of a light reflex having fallen and reducing the brightness of the display screen.

[0012] This invention was made paying attention to such a trouble, and the place made into the technical problem is for there to be no display defect which originates in the manufacturing process on the assumption that the liquid crystal display using the light reflex nature metal electrode which uses silver excellent in the rate of a light reflex and chemical stability as a principal component, and offer a reliable reflective mold liquid crystal display and its manufacture method.

[0013]

[Means for Solving the Problem] Namely, a back plate board with which invention concerning claim 1 has a metal electrode of light reflex nature, An observer lateral electrode board which counters this back plate board, and is arranged, and has a transparent electrode, It is premised on a reflective mold liquid crystal display which is equipped with liquid crystal material enclosed among two-electrodes boards, such as this, impresses voltage between two electrodes, is made to drive liquid crystal material, and carries out a screen display. The above-mentioned metal electrode uses silver as a principal component, and is characterized by containing the 2nd element which can form an intermetallic compound with the 1st element which could form an intermetallic compound and was excellent in adhesion with a substrate of a back plate board with silver, and silver or the 1st element.

[0014] And the 1st element which the above-mentioned metal electrode could use silver as a principal component in

invention concerning this claim 1, and could form an intermetallic compound with silver, and was excellent in adhesion with a substrate of a back plate board, In order that the 2nd element which can form an intermetallic compound is contained with silver or the 1st element, the cohesive force may be strong, silver elements may gather near the center of a metal electrode and a silver comrade may eliminate the 1st element and 2nd element on the both sides among these elements, In an interface field of a metal electrode and a substrate, abundance of the 1st element of the above and the 2nd element becomes high, and an intermetallic compound which consists of the silver-1st element, the silver-2nd element or, and the 1st element-2nd element is generated, and it joins together firmly mutually and is unified. And since the 1st element contained in the above-mentioned intermetallic compound generated in an interface field of a metal electrode and a substrate is excellent in adhesion force with a substrate, it becomes possible [adhesion force of a metal electrode increasing and preventing exfoliation of a metal electrode in a manufacturing process of a liquid crystal display].

[0015] Moreover, since it is the same, in the surface of a metal electrode, silver abundance is low, and in connection with this, since abundance of the 1st element of the above or the 2nd element is high, these 1st elements and the 2nd element combined with oxygen in air, generated an oxide, and have covered the surface of a metal electrode. Generally, since [harder than a silver thin film and] it is chemically stable, this oxide becomes possible [a metal electrode in a manufacturing process of a liquid crystal display getting damaged, and preventing certainly black discoloration and browning by oxidation or sulfuration].

[0016] Thus, since damage and discoloration of a metal electrode in a manufacturing process of a liquid crystal display can be prevented certainly according to invention concerning claim 1, it becomes possible to raise the reliability of a manufactured liquid crystal display by leaps and bounds.

[0017] In addition, in order that silver elements may gather near the center of a metal thin film if heat-treatment is performed after forming a metal thin film which constitutes a metal electrode, it becomes easy to move the 1st element and 2nd element which were eliminated by silver in the direction of the surface of a metal electrode. And it becomes possible for an amount of the wrap above-mentioned oxide to increase the metal-electrode surface, and to prevent the blemish and discoloration much more certainly as a result of the oxidation of the element [1st / element or 2nd element] which moved to the metal-electrode surface. Invention

concerning claim 2 is made for such a reason for technical.

[0018] That is, invention concerning claim 2 is characterized by content of silver in the interior of the above-mentioned metal electrode being higher than content in the surface of a metal electrode a premise [a reflective mold liquid crystal display concerning invention according to claim 1].

[0019] In addition, a thin film of silver which contains Mg as the 1st element and contains Sn as the 2nd element is formed by the sputtering method on a glass substrate, and a result of subsequently having analyzed a presentation of the direction of a film cross section of the above-mentioned thin film after performing 250 degrees C and heat-treatment of 2 hours by Auger analysis is shown in drawing 5 . While silver exists in the interior of a metal electrode in large quantities so that clearly from this drawing 5 , silver hardly exists in a surface field of a metal electrode, but it is occupied by Mg and oxygen. That is, it can check that the metal-electrode surface is covered with a magnesium oxide.

[0020] Moreover, a thin film of silver which contains In as the 1st element and contains Sn as the 2nd element is formed by the sputtering method on a glass substrate, and a result of subsequently having analyzed a presentation of the direction of a film cross section of the above-mentioned thin film after performing 275 degrees C and heat-treatment of 1 hour by Auger analysis is shown in drawing 6 . Silver hardly exists in a surface field of a metal electrode, but it is occupied by In, Sn, and oxygen so that clearly from this drawing 6 . That is, it can check that the metal-electrode surface is covered with an indium oxide list by stannic acid ghost.

[0021] Next, claim 3 and claim 4 are related with invention which specified the 1st element of the above.

[0022] Namely, invention concerning claim 3 is premised on a reflective mold liquid crystal display concerning invention according to claim 1 or 2. Invention which the 1st element of the above is characterized by consisting of one sort or two sorts or more of elements chosen from Mg, In, aluminum, Ti, Zr, Ce, or Si, and requires it for claim 4 It is characterized by the 1st element of the above consisting of Mg or In on the assumption that a reflective mold liquid crystal display concerning invention according to claim 3.

[0023] And as for the 1st element, such as this, it is desirable to add so that it may become the content more than 0.1atm(s) %. 0. It is because adhesion force with a substrate may be insufficient for a case of under 1atm % and it may exfoliate in a manufacturing process of a liquid crystal display. It is more than 0.5atm(s) % preferably. Moreover, as for

this 1st element, it is desirable to add so that it may become the content below 50atm(s) %. It is because acid resistance and basicity-proof may fall depending on a class of the 1st element and chemical injury may be received in a manufacturing process of a liquid crystal display, when 50atm(s) % is exceeded. It is below 30atm(s) % preferably, and if this is exceeded, a rate of a light reflex will fall.

[0024] Next, claim 5 and claim 6 are related with invention which specified the 2nd element of the above.

[0025] Namely, invention concerning claim 5 is premised on a reflective mold liquid crystal display concerning invention according to claim 1 to 4. The 2nd element of the above Sn, Sb, nickel, Zn, Cd, Pd, Au, Bi, Invention which is characterized by consisting of one sort or two sorts or more of elements chosen from germanium, Ga, Cu, Mn, Ba, Fe, or La, and relates to another side and claim 6 is characterized by the 2nd element of the above consisting of Sn on the assumption that a reflective mold liquid crystal display concerning invention according to claim 5.

[0026] And as for the 2nd element, such as this, it is desirable to add so that it may become the content more than 1atm %. It is because adhesion force with a substrate may be insufficient for a case of under 1atm % and it may exfoliate in a manufacturing process of a liquid crystal display. Moreover, as for this 2nd element, it is desirable to add so that it may become the content below 25atm(s) % to silver. It is because chemical injury may be received in a manufacturing process of a liquid crystal display and black discoloration and browning may be produced, when 25atm(s) % is exceeded.

[0027] Moreover, as thickness of the above-mentioned metal electrode concerning claims 1-6, thickness of 50-300nm is desirable. Although a property as a light reflex nature metal electrode is not influenced of thickness of a metal electrode when sufficient rate of a light reflex may not be obtained that it is easy to penetrate incident light when thickness of a metal electrode is less than 50nm and 300nm is exceeded, it is because it becomes disadvantageous in respect of production and cost.

[0028] By the way, the above-mentioned thin film which constitutes a metal electrode concerning this invention has an operation which move a silver element to the interior of a thin film based on the cohesive force, and abundance of the 1st element of the above on the surface of a thin film or the 2nd element is made to increase, is made to generate the oxide, and raises acid resistance and basicity-proof by heat-treating to this. For this reason, this patterning may become difficult in case patterning of the thin film after heat-treatment is carried out to an electrode configuration by

etching. On the other hand, since a thin film before heat-treatment is comparatively excellent in etching fitness, it can avoid the above-mentioned evil by carrying out, before heat-treating the above-mentioned patterning. Invention concerning claim 7 is made based on such a reason for technical.

[0029] Namely, a back plate board with which invention concerning claim 7 has a metal electrode of light reflex nature, An observer lateral electrode board which counters this back plate board, and is arranged, and has a transparent electrode, It is premised on a manufacture method of a reflective mold liquid crystal display which is equipped with liquid crystal material enclosed among two-electrodes boards, such as this, impresses voltage between two electrodes, is made to drive liquid crystal material, and carries out a screen display. The 1st element which could use silver as a principal component on a substrate of the above-mentioned back plate board, could form an intermetallic compound with silver, and was excellent in adhesion with the above-mentioned substrate, A membrane formation production process which forms a thin film which contains the 2nd element which can form an intermetallic compound with silver or the 1st element, It is characterized by providing a patterning production process which carries out patterning of the formed thin film to an electrode configuration, and a heating production process which a thin film by which patterning was carried out is heat-treated [production process], and increases content of the above-mentioned silver in the interior of a thin film.

[0030] According to a manufacture method concerning this invention according to claim 7, in order to etch and carry out patterning of the above-mentioned thin film before heat-treatment which was comparatively excellent in etching fitness, it becomes possible to form that electrode configuration with a sufficient precision. And by heat-treating following this patterning, that acid resistance and basicity-proof are raised and it also becomes possible to prevent discoloration and to aim at improvement in a sex with a blemish-proof further. for this reason, a reflective mold liquid crystal display which was excellent in pattern precision, without having exfoliated, and a metal electrode's having got damaged or producing black discoloration and browning in a manufacturing process -- reliability -- it becomes possible to manufacture highly.

[0031] Next, a method of forming membranes by the sputtering method by using as a target a silver alloy which has the same presentation as this thin film, for example as the membrane formation method of a thin film which constitutes the above-mentioned metal electrode, or a

method of carrying out vapor codeposition, using as a separate evaporation source an element which constitutes the above-mentioned silver alloy is applicable. Moreover, it is also possible to arrange silver, the 1st element of the above, and the 2nd element by turns (for example, the shape of a stripe, the shape of a concentric circle, other configurations), or to prepare a sputtering target which laid the 1st element of the above and the 2nd element partially, and both sides of silver and the above-mentioned element exposed partially on silver, respectively, to perform sputtering using this target, and to form the above-mentioned thin film. In this case, it depends on an exposure product and sputtering speed of each element for a presentation of a thin film formed. Moreover, it is also possible to form membranes by ion plating.

[0032] Moreover, it is desirable for temperature of a substrate to be maintained by low temperature on the occasion of membrane formation of the above-mentioned thin film. In addition, although it is also possible to form membranes where a substrate is heated to an elevated temperature, a rate of a light reflex of a thin film formed in this case may fall. Since it is such, temperature of a substrate at the time of membrane formation is 180 degrees C or less or a room temperature preferably.

[0033] Next, as a substrate of a back plate board with which the above-mentioned thin film is formed, a glass substrate is mentioned, for example. Moreover, in addition to this, application of plastic film, a plastics board, etc. is also possible. This substrate may be colored not only transparence but black, white, and other colors. When a black thing as a substrate is applied, it becomes possible to prevent reflection of light which carried out incidence to a part to which the above-mentioned metal electrode does not exist, and to aim at improvement in contrast of the display screen, without forming a protection-from-light film in a gap part of a picture element of a liquid crystal display, and a picture element (about picture element Mabe). Moreover, when a liquid crystal display uses it in a bright room with much indoor light, while performing a screen display using the above-mentioned indoor light, it is desirable to use a transparent substrate in the case of a transflective-type reflective mold liquid crystal display which contains a lamp in the interior of equipment in preparation for the time of using it in a dark room which runs short of this indoor light. moreover -- if detailed irregularity is prepared in this substrate surface and the above-mentioned metal electrode is formed along with this irregularity -- this metal-electrode surface -- the above -- since detailed irregularity is reproduced, it becomes possible to carry out scattered reflection of the incident light, and to increase an

angle of visibility of the display screen.

[0034] In addition, in forming the above-mentioned thin film on this substrate, it is desirable to wash this substrate surface before membrane formation. As the method of washing, Ion Bon Bert, reverse sputtering, ashing, ultraviolet-rays washing, glow discharge processing, etc. can be illustrated.

[0035] Moreover, a back plate board concerning this invention may be equipped with a transparence thin film of an inorganic oxide which covers the above-mentioned metal electrode in an effective viewing area (field except a terminal area or the seal section) of a liquid crystal display, and protects this. as the transparence thin film of such an inorganic oxide -- SiO2, ZrO2, TiO2, Ta 2O5, and HfO2, CeO2 and aluminum 2O3 etc. -- it can illustrate.

[0036] Next, as a substrate which constitutes an observer lateral electrode board, transparence substrates, such as a glass substrate, plastic film, and a plastics board, can be applied, and transparence electric conduction films, such as ITO and a Nesa membrane, can be applied as a transparent electrode.

[0037] In addition, it is possible to prepare a light-scattering layer in this observer lateral electrode board, to scatter display light over it, and to also make an angle of visibility of the display screen expand to it. This light-scattering layer may be prepared in any of the inside in contact with liquid crystal material of a substrate which constitutes the above-mentioned electrode board, or an outside in contact with a polarization film. Moreover, it is also possible to prepare a color filter layer in an observer lateral electrode board, and to color and carry out color display of the display light to it. Although it is also possible to prepare this color filter layer in a back plate board, in order to employ the high conductivity of a reflector efficiently, preparing in an observer lateral electrode board is more desirable than a back plate board.

[0038] In addition, since electric resistance is small as compared with a transparent electrode of an observer lateral electrode board, as for a metal electrode concerning this invention, it is desirable for a liquid crystal display to use the above-mentioned metal electrode as a scan lateral electrode in the case of a passive-matrix drive method (mainly applied, when liquid crystal material or its orientation condition is STN, ECB, OCB, a HOMEOTORO pick, or antiferroelectricity liquid crystal), and to use a transparent electrode of an observer lateral electrode board for it as a signal electrode. Moreover, in the case of a thing of a active-matrix drive method equipped with driver elements (TFT, MIM, etc.) for every picture element, a driver element may be prepared at any of the above-mentioned back plate board

and an observer lateral electrode board.
[0039]
[Function] According to the reflective mold liquid crystal display concerning claim 1 and invention according to claim 3 to 6 The 1st element which the light reflex nature metal electrode of a back plate board could use silver as the principal component, and could form the intermetallic compound with silver, and was excellent in adhesion with the substrate of a back plate board, In order that the 2nd element which can form an intermetallic compound is contained with silver or the 1st element, the cohesive force may be strong, silver elements may gather near the center of a metal electrode and a silver comrade may eliminate the 1st element and 2nd element on the both sides among these elements, In the interface field of a metal electrode and a substrate, the abundance of the 1st element of the above and the 2nd element becomes high, and the intermetallic compound which consists of the silver-1st element, the silver-2nd element or, and the 1st element-2nd element is generated, and it joins together firmly mutually and is unified.
[0040] And since the 1st element contained in the above-mentioned intermetallic compound generated in the interface field of a metal electrode and a substrate is excellent in the adhesion force with a substrate, it becomes possible [the adhesion force of a metal electrode increasing and preventing exfoliation of the metal electrode in the manufacturing process of a liquid crystal display].
[0041] Moreover, since it is the same, in the surface of a metal electrode, silver abundance is low, and in connection with this, since the abundance of the 1st element or the 2nd element is high, these 1st elements and the 2nd element combined with the oxygen in air, generated the oxide, and have covered the surface of a metal electrode.
[0042] And since [that it is harder than a silver thin film and] this oxide is chemically stable, it becomes possible [the metal electrode in the manufacturing process of a liquid crystal display getting damaged, and preventing certainly the black discoloration and browning by oxidation or sulfuration].
[0043] Next, according to the reflective mold liquid crystal display concerning invention according to claim 2 to 6 The content of the silver in the interior of the above-mentioned metal electrode is larger than the content in the interior of a metal electrode, and it sets on the metal-electrode surface in connection with this. Since the content of the oxide of the 1st element or the oxide of the 2nd element is large, The amount of the wrap above-mentioned oxide increases the metal-electrode surface, and it becomes possible to prevent the part, and its blemish and discoloration much more

certainly.

[0044] Moreover, according to the manufacture method of the reflective mold liquid crystal display concerning invention according to claim 7 Silver is used as a principal component on the substrate of a back plate board. With silver The 1st element which can form an intermetallic compound, The membrane formation production process which forms the thin film which contains the 2nd element which can form an intermetallic compound with silver and the 1st element, The patterning production process which carries out patterning of the formed thin film to an electrode configuration, and the heating production process which the thin film by which patterning was carried out is heat-treated [production process], and increases the content of the silver in the interior of a thin film are provided.

[0045] And in order to etch and carry out patterning of the above-mentioned thin film before the heat-treatment which was comparatively excellent in etching fitness, it becomes possible to form the electrode configuration with a sufficient precision.

[0046] Moreover, in order to heat-treat following this patterning, that acid resistance and basicity-proof are raised, and it also becomes possible to prevent discoloration and to aim at improvement in a sex with a blemish-proof further.

[0047]

[Example] Hereafter, the example of this invention is explained to details with reference to a drawing.

[Example 1] the reflective mold liquid crystal display concerning this example The observer lateral electrode board 2 by which orientation was countered and carried out to the back plate board 1 and this back plate board 1 as shown in drawing 1 , The principal part consists of a sealant 3 which makes the two-electrodes boards 1 and 2, such as this, unify by the periphery, liquid crystal material 4 enclosed among the two-electrodes boards 1 and 2, such as this, and the phase contrast film and the polarization film 5 by which the laminating was carried out to the external surface side of the above-mentioned observer lateral electrode board 2. The above-mentioned back plate board 1 And the glass substrate 11 with a thickness of 0.7mm, It is arranged by the width-of-face [of 285 micrometers], and pitch 300micrometer stripe pattern on this glass substrate 11. Silver is used as a principal component. For magnesium tin 10atm(s) % content as 15atm(s) % and the 2nd element of the above as the 1st element of the above The metal electrode 12 with a thickness of 0.2 micrometers to carry out, It consists of orientation films (not shown) by which the laminating was carried out on this metal electrode 12. Another side and the observer lateral electrode board 2 On a glass substrate 21 and this glass

substrate 21 with a thickness of 0.7mm, width of face of 285 micrometers, a pitch 300micrometer stripe pattern (stripe pattern of the direction which intersects perpendicularly with the above-mentioned metal electrode 12) -- preparing -- and it consists of a transparent electrode 22 with a thickness of 0.24 micrometers which consists of ITO, and an orientation film (not shown) by which the laminating was carried out on this transparent electrode 22.

[0048] And the above-mentioned metal electrode 12 is formed of the following production processes.

[0049] First, after an alkali system surfactant and water washed the surface of a glass substrate 11, it held in the vacuum tub, plasma treatment called reverse sputtering was performed, and it washed further.

[0050] Next, the thin film which constitutes a metal electrode 12 where this glass substrate 11 is maintained to a room temperature was formed, without taking out a glass substrate 11 out of a vacuum tub. That is, tin and magnesium were embedded at some silver targets, and silver, tin, and magnesium prepared the target exposed to the surface, respectively, and formed the above-mentioned thin film with a thickness of 0.2 micrometers by the sputtering method using this target.

[0051] Next, it etched according to the well-known FOTORISO process, and was processed into the above-mentioned stripe pattern, then 250 degrees C and heat-treatment of 2 hours were performed, and the above-mentioned metal electrode 12 was formed.

[0052] In this way, the X diffraction chart of the obtained metal electrode 12 is shown in drawing 2 . Moreover, the X diffraction chart of the metal thin film before heat-treatment is shown in drawing 3 for a comparison. This is not looked at by the X diffraction chart (drawing 3) of the metal electrode before heat treatment to x2 which shows the intermetallic compound of Mg2Sn to the X diffraction chart (drawing 2) of the metal electrode after heat treatment, and the diffraction peak of x1 considered that the intermetallic compound of x3, x4, x5, or AgMg is shown being seen so that these two charts may show. In addition, the peak in drawing 3 (y1, y2) shows silver.

[0053] Moreover, when the sheet resistivity value and the rate of a light reflex of a metal electrode 12 were measured, sheet resistivity values are about 2ohm/**, the rate of a light reflex is 95%, and it has checked having the outstanding conductivity and the light reflex engine performance. Next, change was not looked at by an exterior and its conductivity, and the rate of a light reflex even after leaving it for one month indoors. When the thin film of the silver which contains neither tin nor

magnesium was indoors left for one month for the comparison, the surface was discolored in black and the rate of a light reflex fell sharply.

[0054] Moreover, although 1%NaOH immersion test for 5 minutes was performed in order to check the basicity-proof of a metal electrode, this result did not have change in an exterior and its conductivity, and the rate of a light reflex, either.

[0055] Moreover, it heat-treated, without forming and carrying out patterning of the metal thin film similarly, in order to check a sex with a blemish-proof. This metal thin film passes through the same processing with the same quality of the material as the above-mentioned metal electrode. And when **** reinforcement was examined with the **** strength test machine (HEIDON) using the diamond stylus of a point R0.025, the result with a width of face of 41 micrometers was obtained. Since the aluminum thin film was about 106 micrometers in the same trial, it has checked that the above-mentioned metal electrode had a sex with a blemish-proof superior to an aluminum thin film.

[Example 2] The liquid crystal display concerning this example is the liquid crystal display and abbreviation identitas which start an example 1 except for the configuration of the back plate board 1. Namely, the back plate board 1 concerning this example On a glass plate 11 and this glass substrate 11 with a thickness of 0.7mm, width of face of 285 micrometers, It is arranged by the pitch 300micrometer stripe pattern, and silver is used as a principal component. For an indium tin 11atm(s) % content as 3atm(s) % and the 2nd element of the above as the 1st element of the above The metal electrode 12 with a thickness of 0.2 micrometers to carry out, It consists of orientation films (not shown) by which the laminating was carried out on this metal electrode 12.

[0056] And the above-mentioned metal electrode 12 is formed of the following production processes.

[0057] First, after an alkali system surfactant and water washed the surface of a glass substrate 11, it held in the vacuum tub, plasma treatment called reverse sputtering was performed, and it washed further.

[0058] Next, the thin film which constitutes a metal electrode 12 where this glass substrate 11 is maintained to a room temperature was formed, without taking out a glass substrate 11 out of a vacuum tub. That is, tin and an indium were embedded at some silver targets, and silver, tin, and an indium prepared the target exposed to the surface, respectively, and formed the above-mentioned thin film with a thickness of 0.2 micrometers by the sputtering method using this target.

[0059] Next, it etched according to the

well-known FOTORISO process, and was processed into the above-mentioned stripe pattern, then 275 degrees C and heat-treatment of 1 hour were performed, and the above-mentioned metal electrode 12 was formed.

[0060] In this way, the X diffraction chart of the obtained metal electrode 12 is shown in drawing 4 . The diffraction peak of z2, z3, and z5 which show an intermetallic compound is looked at by the X diffraction chart (drawing 4) of the metal electrode after heat treatment so that this chart may show.

[0061] In addition, z1, z4, z6, z7, and z8 show silver among drawing 4 .

[0062] Moreover, when the sheet resistivity value and the rate of a light reflex of a metal electrode 12 were measured, sheet resistivity values are about 1ohm/**, the rate of a light reflex is 95%, and it has checked having the outstanding conductivity and the light reflex engine performance. Next, change was not looked at by an exterior and its conductivity, and the rate of a light reflex even after leaving it for one month indoors.

[0063] Moreover, although 1%NaOH immersion test for 5 minutes was performed in order to check the basicity-proof of a metal electrode, this result did not have change in an exterior and its conductivity, and the rate of a light reflex, either.

[0064] Furthermore, it heat-treated, without forming and carrying out patterning of the metal thin film similarly, in order to check a sex with a blemish-proof. This metal thin film passes through the same processing with the same quality of the material as the above-mentioned metal electrode. And when **** reinforcement was examined with the **** strength test machine (HEIDON) using the diamond stylus of a point R0.025, the result with a width of face of 20 micrometers was obtained.

[Example 3] The liquid crystal display concerning this example is the liquid crystal display and abbreviation identitas which start an example 1 except for the configuration of the back plate board 1. Namely, the back plate board 1 concerning this example On a glass substrate 11 and this glass substrate 11 with a thickness of 0.7mm, width of face of 285 micrometers, It is arranged by the pitch 300micrometer stripe pattern, and silver is used as a principal component. The indium consists of [tin / 8atm(s) % and] orientation films (not shown) by which the laminating was carried out on 1.5atm(s) % the metal electrode 12 with a thickness of 0.2 micrometers to contain and this metal electrode 12 in zinc as 1.5atm(s) % and the 2nd element of the above as the 1st element of the above.

[0065] And the above-mentioned metal electrode 12 is formed of the following production processes.

[0066] First, after an alkali system

surfactant and water washed the surface of a glass substrate 11, it held in the vacuum tub, plasma treatment called reverse sputtering was performed, and it washed further.

[0067] Next, the thin film which constitutes a metal electrode 12 where this glass substrate 11 is maintained to a room temperature was formed, without taking out a glass substrate 11 out of a vacuum tub. That is, tin, zinc, and an indium were embedded at some silver targets, and silver, tin, zinc, and an indium prepared the target exposed to the surface, respectively, and formed the above-mentioned thin film with a thickness of 0.2 micrometers by the sputtering method using this target.

[0068] Next, it etched according to the well-known FOTORISO process, and was processed into the above-mentioned stripe pattern, then 300 degrees C and heat-treatment of 1 hour were performed, and the above-mentioned metal electrode 12 was formed.

[0069] In this way, when the sheet resistivity value and the rate of a light reflex of a metal electrode 12 which were obtained were measured, sheet resistivity values are about 1ohm/**, the rate of a light reflex is 96%, and it has checked having the outstanding conductivity and the light reflex engine performance. Next, change was not looked at by an exterior and its conductivity, and the rate of a light reflex even after leaving it for one month indoors.

[0070] Moreover, although 1%NaOH immersion test for 5 minutes was performed in order to check the basicity-proof of a metal electrode, this result did not have change in an exterior and its conductivity, and the rate of a light reflex, either.

[0071] Moreover, it heat-treated, without forming and carrying out patterning of the metal thin film similarly, in order to check a sex with a blemish-proof. This metal thin film passes through the same processing with the same quality of the material as the above-mentioned metal electrode. And when **** reinforcement was examined with the **** strength test machine (HEIDON) using the diamond stylus of a point R0.025, the result with a width of face of 20 micrometers was obtained.

[0072]

[Effect of the Invention] According to invention concerning claims 1-6, exfoliation of the metal electrode in the manufacturing process of a liquid crystal display, and since it gets damaged or black discoloration and browning can be prevented certainly, it has the effect of raising the reliability of the manufactured liquid crystal display by leaps and bounds.

[0073] moreover, the reflective mold liquid crystal display which was excellent in pattern precision according to invention concerning claim 7, without

having exfoliated, and the metal electrode's having got damaged or producing black discoloration and browning in a manufacturing process -- reliability -- it has the effect which can be manufactured highly.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The cross section of the reflective mold liquid crystal display concerning an example.

[Drawing 2] The graphical representation showing the X diffraction chart of the metal electrode concerning an example 1.

[Drawing 3] The graphical representation showing the X diffraction chart of the metal electrode concerning the example of a comparison.

[Drawing 4] The graphical representation showing the X diffraction chart of the metal electrode concerning an example 2.

[Drawing 5] The graphical representation showing the presentation of the direction of a cross section of the silver thin film with which magnesium and tin are contained.

[Drawing 6] The graphical representation showing the presentation of the direction of a cross section of the silver thin film with which an indium and tin are contained.

[Drawing 7] The cross section of the reflective mold liquid crystal display concerning the conventional example.

[Description of Notations]

1 Back Plate Board

11 Glass Substrate

12 Metal Electrode

2 Observer Lateral Electrode Board

21 Glass Substrate

22 Transparent Electrode

3 Sealant

4 Liquid Crystal Material

5 Phase Contrast Film and Polarization Film

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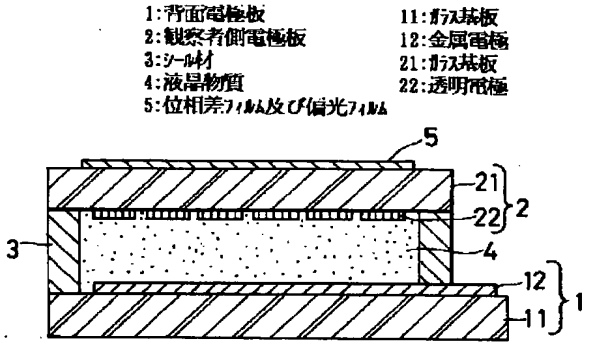
(54)【発明の名称】　反射型液晶表示装置及びその製造方法

(57)【要約】

【目的】　銀を主成分とする光反射性金属電極を備える液晶表示装置を前提とし、その製造工程に起因する表示欠陥がなく信頼性の高い反射型液晶表示装置とその製造方法を提供する。

【構成】　この反射型液晶表示装置は、背面電極板１と、この背面電極板に対向して配向された観察者側電極板２と、これ等両電極板を周辺部で一体化させるシール材３と、これ等両電極板の間に封入された液晶物質４とで主要部が構成されかつ背面電極板１は銀を主成分としマグネシウムを15atm%、錫を10atm%含有する金属電極12を備える。そして金属電極12とガラス基板11との界面領域においてこれら金属の金属間化合物を生成しその密着力の増大が図れ、他方金属電極12表面においてはマグネシウムが空気中の酸素と結合して酸化物を生成しこの酸化物の作用により傷付きや変色を防止して液晶表示装置の信頼性を向上させる。



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【特許請求の範囲】

【請求項１】光反射性の金属電極を有する背面電極板と、この背面電極板に対向して配設されかつ透明電極を有する観察者側電極板と、これ等両電極板間に封入された液晶物質とを備え、両電極間に電圧を印加して液晶物質を駆動させ画面表示する反射型液晶表示装置において、

上記金属電極が、銀を主成分とし、かつ、銀と共に金属間化合物を形成可能で上記背面電極板の基板との密着性に優れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有することを特徴とする反射型液晶表示装置。

【請求項２】上記金属電極の内部における銀の含有率が、金属電極の表面における含有率より高いことを特徴とする請求項１に記載の反射型液晶表示装置。

【請求項３】上記第１の元素が、Ｍｇ、Ｉｎ、Ａｌ、Ｔｉ、Ｚｒ、Ｃｅ又はＳｉから選択された１種又は２種以上の元素から成ることを特徴とする請求項１又は２記載の反射型液晶表示装置。

【請求項４】上記第１の元素が、Ｍｇ又はＩｎから成ることを特徴とする請求項３に記載の反射型液晶表示装置。

【請求項５】上記第２の元素が、Ｓｎ、Ｓｂ、Ｎｉ、Ｚｎ、Ｃｄ、Ｐｄ、Ａｕ、Ｂｉ、Ｇｅ、Ｇａ、Ｃｕ、Ｍｎ、Ｂａ、Ｆｅ又はＬａから選択された１種又は２種以上の元素から成ることを特徴とする請求項１～４のいずれかに記載の反射型液晶表示装置。

【請求項６】上記第２の元素が、Ｓｎから成ることを特徴とする請求項５に記載の反射型液晶表示装置。

【請求項７】光反射性の金属電極を有する背面電極板と、この背面電極板に対向して配設されかつ透明電極を有する観察者側電極板と、これ等両電極板間に封入された液晶物質とを備え、両電極間に電圧を印加して液晶物質を駆動させ画面表示する反射型液晶表示装置の製造方法において、

上記背面電極板の基板上に銀を主成分とし銀と共に金属間化合物を形成可能で上記基板との密着性に優れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有する薄膜を成膜する成膜工程と、成膜された薄膜を電極形状にパターニングするパターニング工程と、パターニングされた薄膜を加熱処理して薄膜内部における上記銀の含有率を増大させる加熱工程とを具備することを特徴とする反射型液晶表示装置の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は反射型液晶表示装置とその製造方法に係り、特に、光反射率が高く明るい画面表示が可能で、しかも製造工程中の諸条件に耐える高信頼性の反射型液晶表示装置とその製造方法の改良に関するものである。

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【０００２】

【従来の技術】液晶表示装置は、絵素毎に電圧の印加を行える電極が配設された一対の電極板とこれ等電極板間に封入された液晶物質とでその主要部が構成され、上記両電極間に電圧を印加することにより液晶物質の配向状態を絵素毎に変化させてこの液晶物質を透過する光の偏光面を制御すると共に、偏光フィルムによりその透過・不透過を制御して画面表示を行うものである。そして、上記一対の電極板の内の一方にカラーフィルター層を有する電極板を適用することによりカラー画面の表示が可能となる。

【０００３】ところで、この種の液晶表示装置としては、液晶表示装置の背面側に位置する電極板（以下背面電極板と称する）の裏面若しくは側面に光源（ランプ）を配置し、背面電極板側から光線を入射させるバックライト型あるいはライトガイド型のランプ内蔵式透過型液晶表示装置が広く普及している。

【０００４】しかし、このランプ内蔵式透過型液晶表示装置においてはそのランプによる消費電力が大きくＣＲＴやプラズマディスプレイ等他の種類のディスプレイと略同等の電力を消費するため、液晶表示装置本来の低消費電力といった特徴を損ない、かつ、携帯先での長時間の利用が困難となるという欠点を有していた。

【０００５】他方、このようなランプを内蔵することなく装置の観察者側に位置する電極板（観察者側電極板と称する）から室内光や自然光等の外光を入射させ、かつ、この入射光を光反射性背面電極板で反射させると共に、この反射光で画面表示する反射型液晶表示装置も知られている。そして、この反射型液晶表示装置ではランプを利用しないことから消費電力が小さく、携帯先での長時間駆動に耐えるという利点を有している。

【０００６】このような反射型液晶表示装置としては、例えば、図７に示すように背面電極板ａの電極ａ２を金属薄膜で構成し、この金属電極ａ２により入射光を反射させて画面表示するものが知られている。尚、図中、ｂは観察者側電極板、ｃは液晶物質、ｄは背面電極板ａと観察者側電極板ｂとを周辺部で一体化させるシール部材、ｂ２Ｒ、ｂ２Ｇ、ｂ２Ｂは絵素部に対応する部位に設けられ各部位を透過する光をそれぞれ赤、緑、青色に着色させるカラーフィルター層、ｂ３は遮光膜を示している。

【０００７】そして、上記背面電極板ａの金属電極ａ２として、従来、安価で光反射率の高いアルミニウム薄膜が利用されているが、このアルミニウム薄膜は水分や塩基によって腐食され易く、これに伴って光反射率の低下や断線を生じて表示欠陥を引き起こし易いという欠点があった。

【０００８】そこで、上記アルミニウム薄膜に代えて水分や塩基に対し安定な銀薄膜を利用する反射型液晶表示

装置が提案されている。すなわち、この銀薄膜においては、ガラス基板上に設けられた厚さ０．２μｍのアルミニウム薄膜に５分間の１％ＮａＯＨ水溶液浸漬処理（液晶表示装置の製造工程中で要求される）を施すとアルミニウム薄膜は完全に溶解して消失するのに対し、同じ浸漬処理を施されても全く影響を受けない利点を有している。

【０００９】

【発明が解決しようとする課題】このように銀薄膜は優れた化学的安定性を有するが、この反面、銀薄膜は柔らかい金属でありまた背面電極板の基板との密着力が劣るため、液晶表示装置の組み立て工程中で傷付いたり基板から剥離し易いという問題点があった。例えば、先端部Ｒ０．０２５ｍｍのダイヤモンド針と引掻強度試験機〔新東科学（株）社製　商品名ＨＥＩＤＯＮ）を使用して上記アルミニウム薄膜の引掻強度と銀薄膜の引掻強度とを比較試験した場合、アルミニウム薄膜の引掻き線幅は１０６μｍに過ぎないのに対し、銀薄膜は引掻き部位を中心として大きく剥離してしまいその引掻き線幅は測定不可能になる。

【００１０】そして、これ等金属電極に生じた傷や剥離は、液晶表示装置の画面中に表示欠陥を引き起こす原因になるため製造された液晶表示装置の信頼性を損なうという問題点を有していた。

【００１１】また、液晶表示装置の製造工程において背面電極板を長時間空気中に保管した場合、上記銀薄膜の表面に酸化物や硫化物が形成されて黒変又は褐変し易く、その光反射率が低下し表示画面の明るさを低下させるという問題点もあった。

【００１２】本発明はこのような問題点に着目してなされたもので、その課題とするところは、光反射率と化学的安定性に優れた銀を主成分とする光反射性金属電極を利用した液晶表示装置を前提とし、その製造工程に起因する表示欠陥がなく信頼性の高い反射型液晶表示装置とその製造方法を提供することにある。

【００１３】

【課題を解決するための手段】すなわち、請求項１に係る発明は、光反射性の金属電極を有する背面電極板と、この背面電極板に対向して配設されかつ透明電極を有する観察者側電極板と、これ等両電極板間に封入された液晶物質とを備え、両電極間に電圧を印加して液晶物質を駆動させ画面表示する反射型液晶表示装置を前提とし、上記金属電極が、銀を主成分とし、かつ、銀と共に金属間化合物を形成可能で背面電極板の基板との密着性に優れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有することを特徴とするものである。

【００１４】そして、この請求項１に係る発明においては上記金属電極が銀を主成分とし、かつ、銀と共に金属間化合物を形成可能で背面電極板の基板との密着性に優

れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有しており、これらの元素のうち銀同志はその凝集力が強く銀元素が金属電極の中央付近に集って第１の元素と第２の元素とをその両側に排除するため、金属電極と基板との界面領域においては上記第１の元素と第２の元素の存在割合が高くなり、銀－第１の元素、銀－第２の元素、あるいは第１の元素－第２の元素から成る金属間化合物を生成し互いに強固に結合して一体化されている。そして、金属電極と基板との界面領域において生成した上記金属間化合物中に含まれる第１の元素は基板との密着力に優れるため、金属電極の密着力が増大し液晶表示装置の製造工程中における金属電極の剥離を防止することが可能となる。

【００１５】また、同じ理由から金属電極の表面においては銀の存在割合が低く、これに伴って上記第１の元素や第２の元素の存在割合が高いためこれら第１の元素や第２の元素が空気中の酸素と結合して酸化物を生成し金属電極の表面を覆っている。この酸化物は、一般に、銀薄膜より硬くしかも化学的に安定なため、液晶表示装置の製造工程中における金属電極の傷付き、及び、酸化若しくは硫化による黒変・褐変を確実に防止することが可能となる。

【００１６】この様に請求項１に係る発明によれば液晶表示装置の製造工程中における金属電極の損傷や変色を確実に防止できるため、製造された液晶表示装置の信頼性を飛躍的に向上させることが可能となる。

【００１７】尚、金属電極を構成する金属薄膜を成膜した後、加熱処理を施すと銀元素が金属薄膜の中央付近に集まるため、銀に排除された第１の元素や第２の元素が金属電極の表面方向へ移動し易くなる。そして、金属電極表面に移動した第１の元素や第２の元素が酸化される結果、金属電極表面を覆う上記酸化物の量が増大しその傷付きや変色をより一層確実に防止することが可能となる。請求項２に係る発明はこのような技術的理由によりなされたものである。

【００１８】すなわち、請求項２に係る発明は、請求項１記載の発明に係る反射型液晶表示装置を前提とし、上記金属電極の内部における銀の含有率が、金属電極の表面における含有率より高いことを特徴とするものである。

【００１９】尚、第１の元素としてＭｇ、第２の元素としてＳｎを含有する銀の薄膜をガラス基板上にスパッタリング法により成膜し、次いで、２５０℃、２時間の加熱処理を施した後の上記薄膜の膜断面方向の組成をオージェ分析により分析した結果を図５に示す。この図５から明らかなように、金属電極の内部には銀が大量に存在する一方、金属電極の表面領域には銀はほとんど存在せずＭｇと酸素によって占められている。すなわち、金属電極表面はマグネシウム酸化物によって覆われていることが確認できる。

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【００２０】また、第１の元素としてＩｎ、第２の元素としてＳｎを含有する銀の薄膜をガラス基板上にスパッタリング法により成膜し、次いで、２７５℃、１時間の加熱処理を施した後の上記薄膜の膜断面方向の組成をオージェ分析により分析した結果を図６に示す。この図６から明らかなように、金属電極の表面領域には銀がほとんど存在せずＩｎ、Ｓｎ及び酸素によって占められている。すなわち、金属電極表面はインジウム酸化物並びに錫酸化物とによって覆われていることが確認できる。

【００２１】次に、請求項３及び請求項４は上記第１の元素を特定した発明に関する。

【００２２】すなわち、請求項３に係る発明は、請求項１又は２記載の発明に係る反射型液晶表示装置を前提とし、上記第１の元素が、Ｍｇ、Ｉｎ、Ａｌ、Ｔｉ、Ｚｒ、Ｃｅ又はＳｉから選択された１種又は２種以上の元素から成ることを特徴とし、また、請求項４に係る発明は、請求項３記載の発明に係る反射型液晶表示装置を前提とし、上記第１の元素がＭｇ又はＩｎから成ることを特徴とするものである。

【００２３】そして、これ等第１の元素は０．１atm％以上の含有率となるように添加することが好ましい。０．１atm％未満の場合には基板との密着力が不足して液晶表示装置の製造工程中で剥離することがあるからである。好ましくは０．５atm％以上である。また、この第１の元素は５０atm％以下の含有率となるように添加することが好ましい。５０atm％を越えた場合、第１の元素の種類によっては耐酸性や耐塩基性が低下し液晶表示装置の製造工程中で化学的損傷を受けることがあるからである。好ましくは３０atm％以下であり、これを越えると光反射率が低下する。

【００２４】次に、請求項５及び請求項６は上記第２の元素を特定した発明に関する。

【００２５】すなわち、請求項５に係る発明は、請求項１～４のいずれかに記載の発明に係る反射型液晶表示装置を前提とし、上記第２の元素が、Ｓｎ、Ｓｂ、Ｎｉ、Ｚｎ、Ｃｄ、Ｐｄ、Ａｕ、Ｂｉ、Ｇｅ、Ｇａ、Ｃｕ、Ｍｎ、Ｂａ、Ｆｅ又はＬａから選択された１種又は２種以上の元素から成ることを特徴とし、他方、請求項６に係る発明は、請求項５記載の発明に係る反射型液晶表示装置を前提とし、上記第２の元素がＳｎから成ることを特徴とするものである。

【００２６】そして、これ等第２の元素は１atm％以上の含有率となるように添加することが好ましい。１atm％未満の場合には基板との密着力が不足して液晶表示装置の製造工程中で剥離することがあるからである。また、この第２の元素は銀に対し２５atm％以下の含有率となるように添加することが好ましい。２５atm％を越えると液晶表示装置の製造工程中で化学的損傷を受け黒変又褐変を生じることがあるからである。

【００２７】また、請求項１～６に係る上記金属電極の

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厚さとしては５０～３００ｎｍの厚さが好ましい。金属電極の厚さが５０ｎｍ未満の場合には入射光を透過し易く十分な光反射率が得られないことがあり、また、３００ｎｍを越えた場合、光反射性金属電極としての特性は金属電極の厚さの影響を受けないが、生産面やコスト面で不利となるからである。

【００２８】ところで、本発明に係る金属電極を構成する上記薄膜は、これに加熱処理を施すことにより銀元素をその凝集力に基づいて薄膜内部へ移動させ薄膜表面の上記第１の元素や第２の元素の存在割合を増大せしめてその酸化物を生成させ耐酸性や耐塩基性を向上させる作用を有する。このため、加熱処理後の薄膜をエッチングによって電極形状にパターニングする際このパターニングが困難になる場合がある。これに対し、加熱処理前の薄膜は比較的エッチング適性に優れるため、上記パターニングを加熱処理前に行うことにより上記弊害を回避できる。請求項７に係る発明はこのような技術的理由に基づいてなされたものである。

【００２９】すなわち、請求項７に係る発明は、光反射性の金属電極を有する背面電極板と、この背面電極板に対向して配設されかつ透明電極を有する観察者側電極板と、これ等両電極板間に封入された液晶物質とを備え、両電極間に電圧を印加して液晶物質を駆動させ画面表示する反射型液晶表示装置の製造方法を前提とし、上記背面電極板の基板上に銀を主成分とし銀と共に金属間化合物を形成可能で上記基板との密着性に優れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有する薄膜を成膜する成膜工程と、成膜された薄膜を電極形状にパターニングするパターニング工程と、パターニングされた薄膜を加熱処理して薄膜内部における上記銀の含有率を増大させる加熱工程とを具備することを特徴とするものである。

【００３０】この請求項７記載の発明に係る製造方法によれば、上記薄膜を比較的エッチング適性に優れた加熱処理前にエッチングしてパターニングするためその電極形状を精度良く形成することが可能となる。そして、このパターニングに続いて加熱処理を施すことによりその耐酸性や耐塩基性を向上させ、更に、変色を防止し耐傷付き性の向上を図ることも可能となる。このため、製造工程中で金属電極の剥離、傷付き、あるいは黒変・褐変を生じることなくパターン精度に優れた反射型液晶表示装置を信頼性高く製造することが可能となる。

【００３１】次に、上記金属電極を構成する薄膜の成膜方法としては、例えば、この薄膜と同一の組成を有する銀合金をターゲットとしてスパッタリング法により成膜する方法、あるいは上記銀合金を構成する元素を別々の蒸発源として共蒸着させる方法等が適用できる。また、銀と上記第１の元素及び第２の元素とを交互に（例えば、ストライプ状、同心円状、あるいは他の形状）に配置したり、銀の上に部分的に上記第１の元素及び第２の

元素とを載置して銀と上記元素の双方がそれぞれ部分的に露出したスパッタリングターゲットを調製し、このターゲットを用いてスパッタリングを行い上記薄膜を成膜することも可能である。この場合、成膜される薄膜の組成はそれぞれの元素の露出面積及びスパッタリング速度に依存する。また、イオンプレーティングにより成膜することも可能である。

【００３２】また、上記薄膜の成膜に際し基板の温度は低温に維持されていることが望ましい。尚、基板を高温に加熱した状態で成膜することも可能であるが、この場合、成膜された薄膜の光反射率が低下することがある。この様なことから、成膜時における基板の温度は、好ましくは１８０℃以下、あるいは室温である。

【００３３】次に、上記薄膜が成膜される背面電極板の基板としては、例えば、ガラス基板が挙げられる。また、この他、プラスチックフィルム、プラスチックボード等の適用も可能である。この基板は透明に限らず、黒色、白色、その他の色に着色したものであってもよい。基板として黒色のものを適用した場合には、液晶表示装置の絵素と絵素との間隙部位（絵素間部位）に遮光膜を形成することなく上記金属電極が存在しない部位に入射した光線の反射を防止して表示画面のコントラストの向上を図ることが可能になる。また、液晶表示装置が、室内光の多い明るい部屋で使用するときには上記室内光を利用して画面表示を行うと共に、この室内光が不足する暗い部屋で使用するときに備えて装置内部にランプを内蔵する半透過型の反射型液晶表示装置の場合には、透明な基板を利用することが望ましい。また、この基板表面に微細な凹凸を設け、この凹凸に沿って上記金属電極を形成すると、この金属電極表面に上記微細な凹凸が再現されるため入射光を乱反射させて表示画面の視野角を増大させることが可能となる。

【００３４】尚、この基板上に上記薄膜を成膜するに当たっては、成膜前に、この基板表面を洗浄することが望ましい。洗浄の方法としては、イオンボンバート、逆スパッタリング、アッシング、紫外線洗浄、グロー放電処理等が例示できる。

【００３５】また、本発明に係る背面電極板は、液晶表示装置の有効表示領域（端子部やシール部を除いた領域）において上記金属電極を覆ってこれを保護する無機酸化物の透明薄膜を備えるものであってもよい。このような無機酸化物の透明薄膜としては、SiO_2、ZrO_2、TiO_2、Ta_2O_5、HfO_2、CeO_2、Al_2O_3 等が例示できる。

【００３６】次に、観察者側電極板を構成する基板としては、ガラス基板、プラスチックフィルム、プラスチックボード等の透明基板が適用でき、また、透明電極としてはＩＴＯやネサ膜等の透明導電膜が適用できる。

【００３７】尚、この観察者側電極板に光散乱層を設けて表示光を散乱させ表示画面の視野角を拡大させることも可能である。この光散乱層は上記電極板を構成する基板の液晶物質と接触する内側、あるいは偏光フィルムと接触する外側のいずれに設けてもよい。また、観察者側電極板にカラーフィルター層を設けて表示光を着色してカラー表示することも可能である。このカラーフィルター層を背面電極板に設けることも可能であるが、反射電極の高い導電性を生かすため、背面電極板より観察者側電極板に設けることが望ましい。

【００３８】尚、本発明に係る金属電極は観察者側電極板の透明電極に比較して電気抵抗が小さいため、液晶表示装置が単純マトリクス駆動方式（液晶物質又はその配向状態がＳＴＮ、ＥＣＢ、ＯＣＢ、ホメオトロピック又は反強誘電性液晶の場合に主に適用されている）の場合には、上記金属電極を走査側電極として使用し、観察者側電極板の透明電極を信号電極として使用することが望ましい。また、絵素毎に駆動素子（ＴＦＴ、ＭＩＭ等）を備えるアクティブマトリクス駆動方式のものの場合には、上記背面電極板と観察者側電極板のいずれに駆動素子を設けてもよい。

【００３９】

【作用】請求項１及び請求項３～６記載の発明に係る反射型液晶表示装置によれば、背面電極板の光反射性金属電極が銀を主成分とし、かつ、銀と共に金属間化合物を形成可能で背面電極板の基板との密着性に優れた第１の元素と、銀又は第１の元素と共に金属間化合物を形成可能な第２の元素を含有しており、これらの元素のうち銀同志はその凝集力が強く銀元素が金属電極の中央付近に集って第１の元素と第２の元素とをその両側に排除するため、金属電極と基板との界面領域において上記第１の元素と第２の元素の存在割合が高くなり、銀－第１の元素、銀－第２の元素、あるいは第１の元素－第２の元素から成る金属間化合物を生成し互いに強固に結合して一体化されている。

【００４０】そして、金属電極と基板との界面領域において生成した上記金属間化合物中に含まれる第１の元素は基板との密着力に優れるため、金属電極の密着力が増大し液晶表示装置の製造工程中における金属電極の剥離を防止することが可能となる。

【００４１】また、同じ理由から金属電極の表面においては銀の存在割合が低く、これに伴って第１の元素や第２の元素の存在割合が高いためこれら第１の元素や第２の元素が空気中の酸素と結合して酸化物を生成し金属電極の表面を覆っている。

【００４２】そして、この酸化物は、銀薄膜より硬くしかも化学的に安定なため、液晶表示装置の製造工程中における金属電極の傷付き、及び、酸化若しくは硫化による黒変・褐変を確実に防止することが可能となる。

【００４３】次に、請求項２～６記載の発明に係る反射型液晶表示装置によれば、上記金属電極の内部における銀の含有率が、金属電極の内部における含有率より大き

く、これに伴い金属電極表面においては第１の元素の酸化物や第２の元素の酸化物の含有率が大きいため、金属電極表面を覆う上記酸化物の量が増大し、その分、その傷付きや変色をより一層確実に防止することが可能となる。

【００４４】また、請求項７記載の発明に係る反射型液晶表示装置の製造方法によれば、背面電極板の基板上に銀を主成分とし銀と共に金属間化合物を形成可能な第１の元素と、銀及び第１の元素と共に金属間化合物を形成可能な第２の元素を含有する薄膜を成膜する成膜工程と、成膜された薄膜を電極形状にパターニングするパターニング工程と、パターニングされた薄膜を加熱処理して薄膜内部における銀の含有率を増大させる加熱工程とを具備している。

【００４５】そして、上記薄膜を比較的エッチング適性に優れた加熱処理前にエッチングしてパターニングするためその電極形状を精度良く形成することが可能となる。

【００４６】また、このパターニングに続いて加熱処理を施すためその耐酸性や耐塩基性を向上させ、更に、変色を防止し耐傷付き性の向上を図ることも可能となる。

【００４７】

【実施例】以下、図面を参照して本発明の実施例について詳細に説明する。

［実施例１］この実施例に係る反射型液晶表示装置は、図１に示すように、背面電極板１と、この背面電極板１に対向して配向された観察者側電極板２と、これ等両電極板１、２を周辺部で一体化させるシール材３と、これ等両電極板１、２の間に封入された液晶物質４と、上記観察者側電極板２の外面側に積層された位相差フィルム及び偏光フィルム５とでその主要部が構成されている。そして、上記背面電極板１は、厚さ０．７㎜のガラス基板１１と、このガラス基板１１上に、幅２８５μm、ピッチ３００μmのストライプパターンに配設され、銀を主成分とし、上記第１の元素としてマグネシウムを１５atm %、上記第２の元素として錫を１０atm %含有する厚さ０．２μmの金属電極１２と、この金属電極１２上に積層された配向膜（図示せず）とで構成され、他方、観察者側電極板２は、厚さ０．７㎜のガラス基板２１と、このガラス基板２１上に幅２８５μm、ピッチ３００μmのストライプパターン（上記金属電極１２と直交する方向のストライプパターン）に設けらかつＩＴＯから成る厚さ０．２４μmの透明電極２２と、この透明電極２２上に積層された配向膜（図示せず）とで構成されている。

【００４８】そして、上記金属電極１２は、以下の工程により形成されている。

【００４９】まず、ガラス基板１１の表面をアルカリ系界面活性剤と水とで洗浄した後、真空槽内に収容し、逆スパッタリングと呼ばれるプラズマ処理を施してさらに洗浄した。

【００５０】次に、ガラス基板１１を真空槽中から取り出すことなく、このガラス基板１１を室温に維持した状態で金属電極１２を構成する薄膜を成膜した。すなわち、銀のターゲットの一部に錫とマグネシウムを埋め込んで銀、錫及びマグネシウムがそれぞれ表面に露出するターゲットを調製し、このターゲットを用いてスパッタリング法により厚さ０．２μmの上記薄膜を成膜した。

【００５１】次に、周知のフォトリソプロセスに従いエッチングして上記ストライプパターンに加工し、続いて、２５０℃、２時間の加熱処理を施して上記金属電極１２を形成した。

【００５２】こうして得られた金属電極１２のＸ線回折チャートを図２に示す。また、比較のため加熱処理前の金属薄膜のＸ線回折チャートを図３に示す。この２つのチャートから分かるように、熱処理後の金属電極のＸ線回折チャート（図２）には、Mg_2Snの金属間化合物を示すｘ2、ｘ3、ｘ4、ｘ5やＡｇＭｇの金属間化合物を示すと思われるｘ1の回折ピークが見られるのに対し、熱処理前の金属電極のＸ線回折チャート（図３）にはこれが見られない。尚、図３中のピーク（ｙ1 、ｙ2）は銀を示すものである。

【００５３】また、金属電極１２の面積抵抗値と光反射率を測定したところ、面積抵抗値は約２Ω／□、光反射率は９５％であり、優れた導電性と光反射性能を有することが確認できた。次に、室内に１ケ月放置した後も外観上及びその導電性と光反射率に変化は見られなかった。比較のため、錫やマグネシウムを含有しない銀の薄膜を室内に１ケ月放置したところ、表面が黒変し光反射率が大幅に低下した。

【００５４】また、金属電極の耐塩基性を確認するため５分間の１％ＮａＯＨ浸漬試験を行ったが、この結果も外観上及びその導電性と光反射率に変化がなかった。

【００５５】また、耐傷付き性を確認するため、同様に金属薄膜を成膜し、パターニングすることなく、加熱処理を施した。この金属薄膜は上記金属電極と同一材質で同一の処理を経たものである。そして、先端部Ｒ０．０２５のダイヤモンド針を使用し引掻強度試験機（ＨＥＩＤＯＮ）により引掻強度を試験したところ、幅４１μmの結果が得られた。同様の試験でアルミニウム薄膜が約１０６μmであることから、上記金属電極はアルミニウム薄膜より優れた耐傷付き性を有することが確認できた。

［実施例２］この実施例に係る液晶表示装置は、背面電極板１の構成を除いて実施例１に係る液晶表示装置と略同一である。すなわち、この実施例に係る背面電極板１は、厚さ０．７㎜のガラス板１１と、このガラス基板１１上に、幅２８５μm、ピッチ３００μmのストライプパターンに配設され、銀を主成分とし、上記第１の元素としてインジウムを３atm %、上記第２の元素として錫

を１１atm %含有する厚さ０．２μmの金属電極１２と、この金属電極１２上に積層された配向膜（図示せず）とで構成されている。

【００５６】そして、上記金属電極１２は、以下の工程により形成されている。

【００５７】まず、ガラス基板１１の表面をアルカリ系界面活性剤と水とで洗浄した後、真空槽内に収容し、逆スパッタリングと呼ばれるプラズマ処理を施してさらに洗浄した。

【００５８】次に、ガラス基板１１を真空槽中から取り出すことなく、このガラス基板１１を室温に維持した状態で金属電極１２を構成する薄膜を成膜した。すなわち、銀のターゲットの一部に錫とインジウムを埋め込んで銀、錫及びインジウムがそれぞれ表面に露出するターゲットを調製し、このターゲットを用いてスパッタリング法により厚さ０．２μmの上記薄膜を成膜した。

【００５９】次に、周知のフォトリソプロセスに従いエッチングして上記ストライプパターンに加工し、続いて、２７５℃、１時間の加熱処理を施して上記金属電極１２を形成した。

【００６０】こうして得られた金属電極１２のＸ線回折チャートを図４に示す。このチャートから分かるように、熱処理後の金属電極のＸ線回折チャート（図４）には、金属間化合物を示すｚ2、ｚ3、ｚ5の回折ピークが見られる。

【００６１】尚、図４中、ｚ1、ｚ4、ｚ6、ｚ7、ｚ8は銀を示すものである。

【００６２】また、金属電極１２の面積抵抗値と光反射率を測定したところ、面積抵抗値は約１Ω／□、光反射率は９５％であり、優れた導電性と光反射性能を有することが確認できた。次に、室内に１ケ月放置した後も外観上及びその導電性と光反射率に変化は見られなかった。

【００６３】また、金属電極の耐塩基性を確認するため５分間の１％ＮａＯＨ浸漬試験を行ったが、この結果も外観上及びその導電性と光反射率に変化がなかった。

【００６４】更に、耐傷付き性を確認するため、同様に金属薄膜を成膜し、パターニングすることなく、加熱処理を施した。この金属薄膜は上記金属電極と同一材質で同一の処理を経たものである。そして、先端部Ｒ０．０２５のダイヤモンド針を使用し引掻強度試験機（ＨＥＩＤＯＮ）により引掻強度を試験したところ、幅２０μmの結果が得られた。

［実施例３］この実施例に係る液晶表示装置は、背面電極板１の構成を除いて実施例１に係る液晶表示装置と略同一である。すなわち、この実施例に係る背面電極板１は、厚さ０．７mmのガラス基板１１と、このガラス基板１１上に、幅２８５μm、ピッチ３００μmのストライプパターンに配設され、銀を主成分とし、上記第１の元素としてインジウムを１．５atm %、上記第２の元素として亜鉛を８atm %と錫を１．５atm %含有する厚さ０．２μmの金属電極１２と、この金属電極１２上に積層された配向膜（図示せず）とで構成されている。

【００６５】そして、上記金属電極１２は、以下の工程により形成されている。

【００６６】まず、ガラス基板１１の表面をアルカリ系界面活性剤と水とで洗浄した後、真空槽内に収容し、逆スパッタリングと呼ばれるプラズマ処理を施してさらに洗浄した。

【００６７】次に、ガラス基板１１を真空槽中から取り出すことなく、このガラス基板１１を室温に維持した状態で金属電極１２を構成する薄膜を成膜した。すなわち、銀のターゲットの一部に錫、亜鉛及びインジウムを埋め込んで銀、錫、亜鉛及びインジウムがそれぞれ表面に露出するターゲットを調製し、このターゲットを用いてスパッタリング法により厚さ０．２μmの上記薄膜を成膜した。

【００６８】次に、周知のフォトリソプロセスに従ってエッチングして、上記ストライプパターンに加工し、続いて、３００℃、１時間の加熱処理を施して上記金属電極１２を形成した。

【００６９】こうして得られた金属電極１２の面積抵抗値と光反射率を測定したところ、面積抵抗値は約１Ω／□、光反射率は９６％であり、優れた導電性と光反射性能を有することが確認できた。次に、室内に１ケ月放置した後も外観上及びその導電性と光反射率に変化は見られなかった。

【００７０】また、金属電極の耐塩基性を確認するため５分間の１％ＮａＯＨ浸漬試験を行ったが、この結果も外観上及びその導電性と光反射率に変化がなかった。

【００７１】また、耐傷付き性を確認するため、同様に金属薄膜を成膜し、パターニングすることなく、加熱処理を施した。この金属薄膜は上記金属電極と同一材質で同一の処理を経たものである。そして、先端部Ｒ０．０２５のダイヤモンド針を使用し引掻強度試験機（ＨＥＩＤＯＮ）により引掻強度を試験したところ、幅２０μmの結果が得られた。

【００７２】

【発明の効果】請求項１～６に係る発明によれば、液晶表示装置の製造工程中における金属電極の剥離、傷付き、あるいは黒変・褐変を確実に防止できるため、製造された液晶表示装置の信頼性を飛躍的に向上させる効果を有する。

【００７３】また、請求項７に係る発明によれば、製造工程中で金属電極の剥離、傷付き、あるいは黒変・褐変を生じることなくパターン精度に優れた反射型液晶表示装置を信頼性高く製造できる効果を有する。

【図面の簡単な説明】

【図１】実施例に係る反射型液晶表示装置の断面図。

【図２】実施例１に係る金属電極のＸ線回折チャートを

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示すグラフ図。

【図３】比較例に係る金属電極のＸ線回折チャートを示すグラフ図。

【図４】実施例２に係る金属電極のＸ線回折チャートを示すグラフ図。

【図５】マグネシウムと錫が含まれる銀薄膜の断面方向の組成を示すグラフ図。

【図６】インジウムと錫が含まれる銀薄膜の断面方向の組成を示すグラフ図。

【図７】従来例に係る反射型液晶表示装置の断面図。

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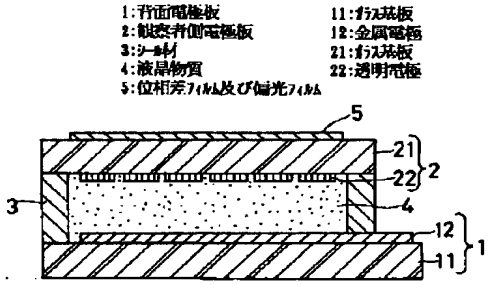
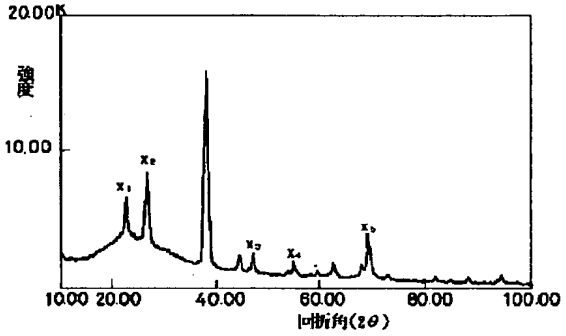
【符号の説明】

１　背面電極板
１１　ガラス基板
１２　金属電極
２　観察者側電極板
２１　ガラス基板
２２　透明電極
３　シール材
４　液晶物質
５　位相差フィルム及び偏光フィルム

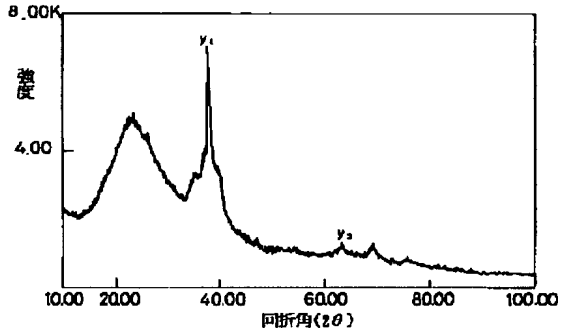
【図１】



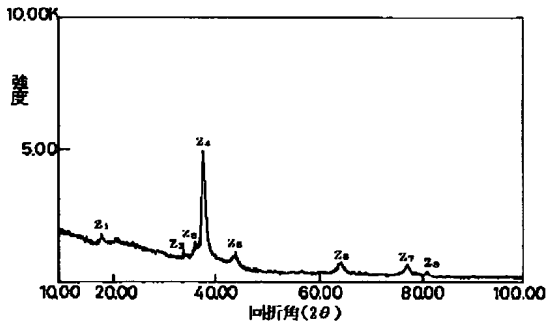
【図２】



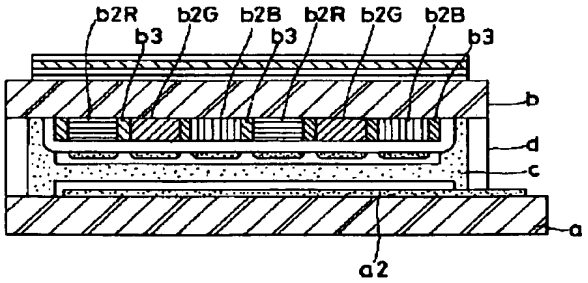
【図３】



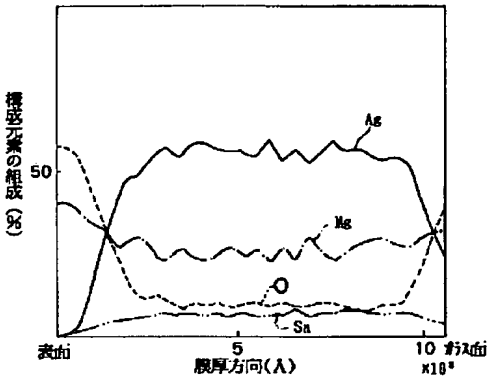
【図４】



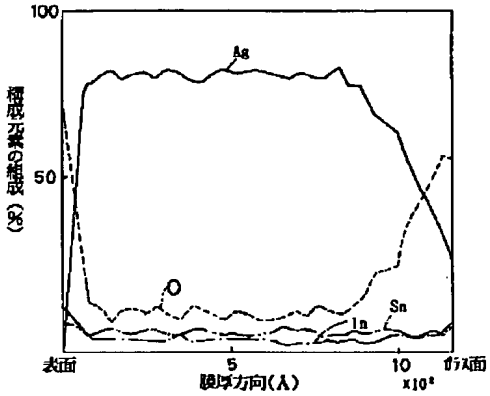
【図７】



【図５】


構成元素の組成（%）
50
Ag
Mg
O
Sn
表面
5
10
ガス面
膜厚方向(Å)
x10²

【図６】


100
構成元素の組成（%）
50
Ag
O
Sn
In
表面
5
10
ガス面
膜厚方向(Å)
x10²